

ARPA-E AMPED 0675-1565

A Multi-Purpose, Intelligent, and Reconfigurable Battery Pack Health Management System

Participants

Hosam Fathy, PI (Penn State University)

Sean Brennan, co-PI (Penn State University)

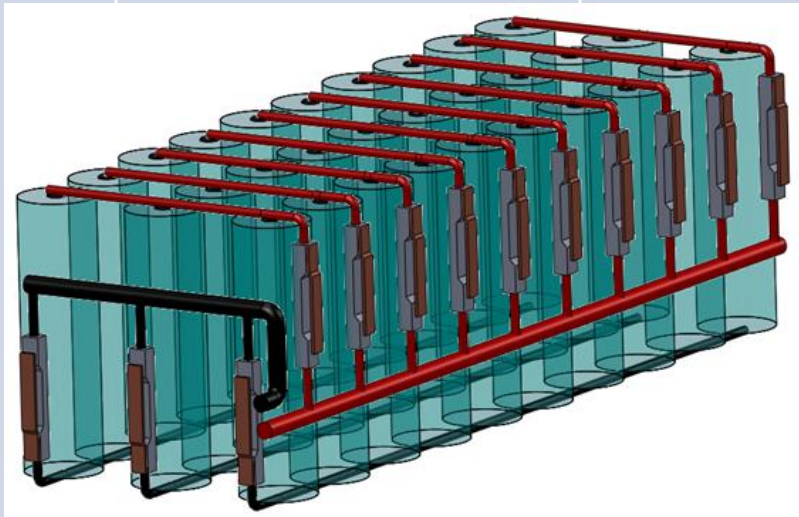
Joel Anstrom, co-PI (Penn State University)

Chris Mi, industrial partner (Gannon Motors & Controls, Univ. of Michigan – Dearborn)

Brian Sisk, industrial advisor (Johnson Controls Power Solutions)

Description of Technology and Value Proposition (1)

Pack design characteristic	State of the art	Proposed technology	Expected system benefits
Pack architecture	Modular series/parallel cell arrangement with balancing circuitry	Reconfigurable cell arrangement; allows dynamic rerouting of current & isolation/ replacement of damaged cells	<ul style="list-style-type: none">- Pack downsizing- Repurposing for grid applications- Novel health estimation- Plug-and-play health management



Description of Technology and Value Proposition (2)

Pack design characteristic	State of the art	Proposed technology	Expected system benefits
Health estimation algorithms	Kalman/extended Kalman filtering (or similar algorithm) applied to pack; possible multiplexing for cells	Differential & targeted diagnostics	<ul style="list-style-type: none">- 2x improvement in diagnostic accuracy- 100x reduction in estimation time
Health management algorithms	Strict limits on cell current/voltage/temperature; possible optimization of supervisory power management for battery health	Plug-and-play health management (through dynamic rerouting of current)	<ul style="list-style-type: none">- 25% reduction in likelihood of inadvertent overcharging/overdischarging of individual cells

Validation Plan

Validation Task	Year 1				Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Spec sheet for full pack												
Design of full pack												
HIL <u>testbed</u> construction												
Optimal design of HIL experiments												
Full pack implementation/commissioning												
Simulation-based testing												
Laboratory HIL testing												
Full pack testing												
Battery chemistry sensitivity study												
(Stretch goal) In-vehicle demo												